

# Plastics for better, lighter automobiles

Plastics are helping automotive designers and engineers to achieve an important goal of designing exciting automobiles that are also lighter and therefore more powerful and efficient.

The very component that is used to enter an automobile, the door handle, is more than likely to be made of plastic. Most surfaces in the interior – steering, switches, dashboard controls and more, are more than likely to be made out of plastics. About 50 per cent of an automobile is made of plastics even though plastics account for only 10 to 15 per cent of its total weight (approximately 400 pounds). Plastic is made attractive by its ability to ensure design freedom and light weighting. Holding the key to a host of safety and performance breakthroughs in present-day autos, plastics in automotive design,

have contributed to a multitude of innovations in safety, performance and fuel efficiency. Presenting designers the freedom to create innovative concepts that in many instances would otherwise be impractical or virtually impossible, plastics are helping automakers to adopt modular assembly practices, lower production costs, improve energy management, achieve better dent resistance, and use advanced styling techniques for sleeker, more aerodynamic exteriors.

## DESIGN FREEDOM

Automobile design engineers face many constrictions when designing with metal. Low-cost, single-unit production of large automobile sections, such as a front grille, is nearly impossible when

Plastic tolerance rings and bearings from Saint Gobain Performance Plastics help automakers address issues like vehicle security, design freedom and light weighting.



using metal.

Plastic offers auto engineers a variety of practical, cost-effective alternatives, as well as tremendous advantages over traditional automobile production materials. Plastics allow auto engineers to have greater freedom in styling, building, and placing components, and give them the opportunity to combine several complex parts into a single, integrated piece. Plastics make this possible, while lowering manufacturing costs. New processes enable manufacturers to reuse scrap plastic and recycle used plastic cost-effectively. Also, plastic components weigh approximately 50 per cent less than their steel counterparts. This enables automobile components to be substantially lighter, while retaining needed strength, and contributes to an overall lighter vehicle.

Diisocyanates (DII) are used to make many types of polyurethane products found throughout the automobile kingdom. Polyurethanes made with



Race car designer Gordon Murray's creation, the T.25 is made from light weight plastics.

DII chemistry can help make vehicles stronger, lighter, and more comfortable. Physics in the crumple zone has already demonstrated how less stiff materials, like plastics, can help prevent injury and save lives. Located in the front crumple zone, the plastic fan (shroud reservoir) of 2000 Dodge Dakota and Durango saved 1.1 lbs per vehicle even as the plastic bumper beam of the Saturn VUE saved 2.5 lbs in vehicle weight. Composite drive shafts made of carbon and polymer fibre designed to break into small fibre fragments or 'broom' upon failure, pose little danger. LANXESS' hybrid technology ensures a 30 per cent lighter air bag housing. LANXESS' polyamide composite sheet hybrid technology may result in a higher weight saving and design freedom over Polyamide 6. DSM's Akulon polyamide 6 (UV-stabilised and glass fibre reinforced) grades for auto parts eliminate the need for painting of external comps like ORVMs. Hella turned to SABIC for Volkswagen Golf's distinctive fog lamp. SABIC's ULTEM fit the bill, helping Hella address requirements like thermal resistance in a compact space, glare reduction, increased design freedom and light weighting.

**LIGHT WEIGHTING, COST SAVINGS**

An interesting as well as a demanding

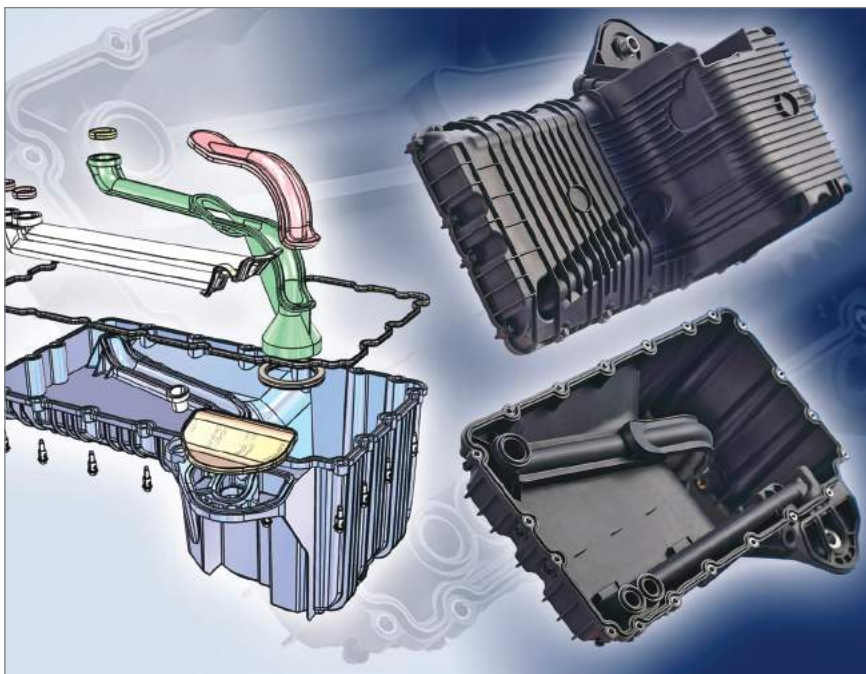


An 'alloy' wheel made of BASF Ultramid polyamide with long-glass material results in 3 kg weight saving over a traditional metal wheel.

area where plastic is finding much use is bearings (read bushings). Offered by companies like Igus, Saint Gobain and GGB, these are strong and durable. However what makes them a top choice is their light weight when compared to the metal counterparts. They cost less too, apart from their ability to run longer in harsh environments and under

adverse conditions. Non-corrosive plastic bearings have come to find use in areas like soft top mechanisms, hinges, seating systems, suspension linkages, wipers, steering systems, foot pedals, gear actuators, intake manifolds, throttle bodies, pedal assemblies, seat belts and EGR. According to Chris Needs, Global Market Manager, Automotive Chassis and Powertrain, Saint-Gobain Performance Plastics, Bearings and Tolerance Rings SBU, "Bearings play a key role in the automotive powertrain, minimising friction that can occur between moving parts." Willem De Vos, CEO of the Society of Plastics Engineers, added: "We are not stopping at the current use of plastics in cars, plastic cars will soon be a reality." Willem De Vos drew attention to the Reva whose body is made out of plastics, and to applications like plastics replacing glass for windshields with a scratch resistant coating. This, according to De Vos, will result in substantial energy saving. Opined De Vos, "The end consumer will most likely demand more weight reduction, enhanced safety and comfort and new designs. Plastics are the best material and process technology to answer to this."

An interesting development is



ElringKlinger built a multi-functional car oil pan from DuPont Zytel (PA 66 nylon resin).

**How are plastics helping with design freedom in automobiles?**

Styling and aesthetics are important in any vehicle design. With help of plastic processing techniques like injection moulding, it is possible to produce complicated 2D, 3D shapes with plastics. The other advantages are durability, impact and corrosion resistance, apart from various colouring and painting options. It is possible, with plastics, to design highly complicated and intricate parts along with part integration to meet the styling requirements and improve aesthetics. In a nutshell, the benefits are obvious – plastics make cars lighter, improve their fuel economy, are easy to process and offer virtually unlimited design freedom. Thanks to our innovative chemical-based sustainable material solutions and process technologies, we are well placed in this respect. Interestingly, unlike rubber, which can be coloured only in black, Thermoplastic Polyurethanes (TPUs) can be custom coloured as per the requirement.



**Ajay Durrani,**  
Managing Director & Senior  
Country Representative –  
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MaterialScience Pvt Ltd

**How are plastics helping to lighten the weight of automobiles, thereby reducing carbon footprint and enhancing fuel efficiency?**

Plastics that we offer have come to play an important role in weight reduction through replacement of metals and glass in vehicles. For example, automotive glazing and entire panoramic roofs are increasingly made from polycarbonate, which is only half the weight of glass. This benefits the environment because the more lightweight the car, the lower its fuel consumption and CO<sub>2</sub> emissions. It's even possible to make an entire rear hatch from polycarbonate, including directional

indicators, brake lights and rear lights. Glass filled TPU's have replaced metals thereby reducing the weight. There are many other components which can be made using the various solutions from Bayer MaterialScience.

**What is the future of plastics in automobiles?**

Mankind is becoming increasingly mobile. The number of commuters is increasing, as is the transport of freight. This is also leading to a growing demand for environmental awareness, efficiency, individuality and comfort in the transportation sector. Whether transportation is taking place on land, sea or air, plastics are a long-established part of a vehicle's material inventory and will remain. Bayer MaterialScience is well placed in this respect thanks to its innovative chemical-based sustainable material solutions and process technologies. Plastics have great scope in automobiles as new technologies and materials are being developed to address the needs like safety, emission norms, weight reduction, etc. In existing cars the average plastics usage is around 11 per cent and opportunities are there to replace the traditional materials. Polycarbonate and Polyurethane continue to offer solutions to the challenges we face in the sphere of mobility and many other segments. Moreover, TPU which is a part of Thermoplastic Elastomer family will continue to replace rubber as it offers higher productivity, design freedom, it can replicate complex mold-geometry and is recyclable. Loyal to our mission of 'Science for a Better Life', we are determined to contribute its bit towards a better future of mobility.

the plastic alloy wheel. Tencate and Kringlan are co-operating to design and produce a full carbon fibre reinforced composite wheel for high performance cars. A thermoplastic composite material developed by Tencate has been qualified for the purpose. Composite containing glass fibre will facilitate significant weight reduction and chassis parts, says an expert at DSM. DSM is a partner in the 4-year 'ENLIGHT' (Enhanced Lightweight Design) project, which also includes car companies Jaguar, Renault, Volkswagen and Volvo. ENLIGHT aims to accelerate the technological

development of a portfolio of materials, which together offer a strong potential to reduce weight as well as the carbon footprint. Looked upon as a material for hybrids and electric vehicles of the future along side materials development, processing and automation techniques for automotive composites are being pursued in numerous industrial and academic collaborations. For example, a process for the manufacture of Class A carbon fibre composite exterior panels (by partners Zoltek, KraussMaffei, Henkel, Chomarar, and Ruhl); quickstep resin spray transfer tech that enables

carbon composite automotive panels to be produced 'in minutes' at low cost, with a high quality finish direct from the mould; an automated production of a CFRP vehicle bonnet in only fifteen minutes with a gap impregnation machine; and a new tooling tech by BREYER and the Institut für Kunststoffverarbeitung (IKV) Aachen and Hille Engineering GmbH & Co KG., Germany.

Challenges continue. Lawrence Berkowski, Senior Vice President, Engineering Plastics, BASF Corporation is known to have said that the bigger

**How are plastics helping with design freedom in automobiles?**

Plastic itself as a material can be modified into various shapes and sizes as per the requirements of various processes, including injection moulding, blow moulding, rotational moulding, extrusion, calendaring and thermoforming. It is also possible to improve the mechanical properties of the raw material with the use of additives and reinforcements to achieve the desired product strength apart from achieving the performance requirements. Re-use and recyclability of plastic is also one of the core reasons, which makes the material attractive for product designers. With all these specialities, a designer is at the liberty to design a product he wishes to create without fearing about its manufacturing feasibility. Plastic product manufacturing also accounts for less number of steps till it attains finality and is deliverable. Commodity, engineering, high heat resistant parts and elastomers are some of the types of plastics, which provide a combination of properties. In a nut shell, with the use of plastics, numerous requirements ranging from aesthetic, functional, reliable, light weight, styling freedom, colour moulding, ease of assembly to the ability to work under high and fluctuating temperature ranges can be attained.

**How are plastics helping to light weight automobiles, thereby reducing carbon footprint and**



**Ramchandra Shejwal,**  
Vice President,  
Varroc Polymers

**enhancing fuel efficiency?**

Through continuous research, scientists have developed resins which help to engineer plastics to possess properties that are equivalent to those of a metal. Not only has this helped to save weight on account of density, but also on the account of less energy consumption due to simplification of the manufacturing process. Because of light weighting, fuel consumption has come down in automobiles. If they can now travel faster, their CO<sub>2</sub> emission is less. The CO<sub>2</sub> emission has reduced not only when operating, but also when being manufactured at the factory. With IMDS (International material Data System), it is possible to work out the recyclability and reusability.

**What is the future of plastics in automobiles?**

Plastic is a highly promising material for future development. It has replaced metal and steel to a good extent in vehicle interiors and exteriors. Nylon-based plastics are finding use in under bonnet applications with exposure to high temperatures. Plastic parts are finding a place near high temperature components like engine cylinder head, block, manifolds, etc. Critically sensitive performance parts like accelerator and brake pedals are also made of plastics. At a level imaginable, plastics could be projected as a material suitable to make crucial engine parts except piston, cylinder and crankshaft.



Varroc Polymers manufactures many plastic parts.

the part, the more problematic it is to shift from metal to plastic because the raw material costs are higher. Plastics continue to penetrate newer areas like cylinder head covers, manifolds and wheels as glass fibre reinforced plastics make high performance applications viable. Thermoplastics have moved enough forward so as to make Faurecia use it to make seat frames. An 'alloy' wheel made of BASF Ultramid polyamide with long-glass material results in 3 kg weight saving over a traditional metal wheel. Global demand for plastics continues to grow on an average by 5 per cent per year. The amount of plastics used in Asian cars may be less than those in Europe or US, but the fact is, plastics will continue to grow in use; will play an important role in mobility media and

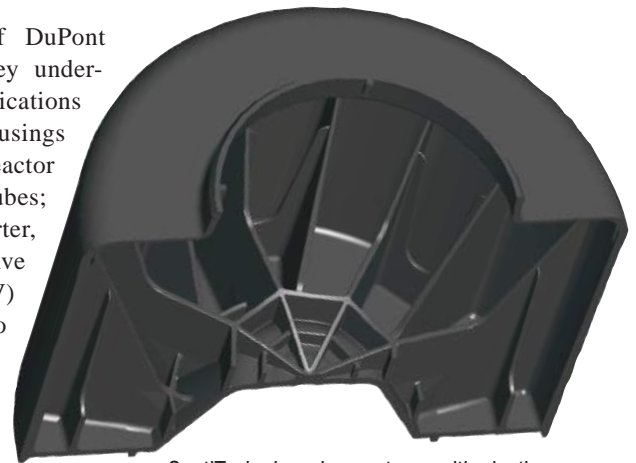
ensure further freedom of design. It will also create new avenues to light weight, and reduce fuel consumption as well as the carbon footprint.

Materials like the glass fibre reinforced PA 66 nylon from DuPont have been helping automakers to address emission regulation requirements, proving a basis for critical air and fuel system pollution control components, many of which would have been extremely costly and too complex to manufacture in metal. “The automotive industry is racing to develop safe, fun and affordable vehicles that are much more fuel efficient and produce far fewer emissions,” said Pat E. Lindner, President, DuPont Performance Polymers. Powertrain systems are the primary target for today’s light weighting efforts while aluminium is expected to be relied on heavily to meet new CAFE standards. Engineering plastics, advanced composites and multi-material or hybrid solutions are set to serve the industry well. “The most effective approach involves value-chain collaboration to understand the needs and develop new materials, new designs, new manufacturing methods – or all three – to find solutions,” said


Jeff Sternberg, director of DuPont Automotive Technology. Key under-the-bonnet and other area applications include charcoal canister housings and tubings; air injector reactor seats, guides, valves and tubes; and vacuum control, diverter, thermal delay and positive crankshaft ventilation (PCV) valves. Applications also include intake manifolds, radiator fan shrouds. An innovative plastic piston in the ContiTech air spring system is 75 per cent lighter than a steel piston. Made from using a special plastic and employing a new simulation method, the overall weight saving is as much as 12 kg per truck axle.

#### BACK TO THE FUTURE

It takes numerous parts to make a modern automobile. The fact that it is mostly made out of steel for structural stability is changing. Especially in view of the fact that cutting edge tech like large scale 3D printing is becoming a reality. As the trend to reduce the number of parts by bunching them to attain an amount of modularity gains force, plastics are



ContiTech air spring systems with plastic pistons dramatically reduce the weight of air spring systems and make them corrosion resistant.

coming to play an increasingly important role. Lead designer Jim Kor, for example, came up with Urbee 2, a small two-passenger vehicle with 3D printed exterior, which is highly efficient, light and extremely safe in spite of being made of plastic. The T.25 three-seater car made from light weight plastics was an outcome of the efforts of race car designer Gordon Murray. Weighing upon the fact that automakers need to change from being a steel-based industry, and quickly enough to not risk losing their technological lead, the T.25 excelled when tested against other comparable vehicles since it is a light weight design that does 80 miles per gallon. In their travel to the future, automakers have already begun to replace traditional materials with adhesives and plastics. While industry experts claim that plastics are the way of the future owing to their light weight and the fact that they are stronger and safer than traditional materials, according to a market research report published by MarketsandMarkets, the global plastic car industry is expected to more than double from US\$ 21.6 billion last year to \$ 46.1 billion by 2016. Back to the future, and an obvious synergy between the new breed of electric 'smart' cars and light weight plastics and adhesives is set to unfold, also, lower production costs would give companies such as the electric car maker Tesla and the tech giant Google, the opportunity to produce a new breed of 21st century car at a lower price than traditional vehicles. 



igus replaced conventional bearings with plastic bearings on a SmartFour, and had it tour the world.